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(54) METHOD OF EMBOSSING PLASTICS FILM AND MANUFACTURING A BAG STRUCTURE

(71) We, MOBIL OIL CORPORATION, a Corporation organised and existing under the laws of the State of New York, United States of America, of 150 East 42nd Street, New York, New York 10017, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of embossing plastics film, preferably polyethylene film, of 0.025 mm or less thickness, and to disposable, embossed plastics bags in the form of a bag structure comprising a series of detachable bags in a continuous strip made from one or more webs of such embossed film.

Disposable bags, particularly for use as sandwich bags and other food wrappers for one-time use, have been made typically of polyethylene film of 0.025 mm thickness, or less, for example of thicknesses as thin as 0.015 and 0.020 mm. The particular thickness used varies with the use and the strength demanded which, for the usual type of sandwich wrapping, is very low. Such bags are easily made at high speed by extruding a tubular web and making transverse heat seals thereacross, with separating or tear-off lines for ease of separation of the resulting bags; the web may be slit or cut at one longitudinal edge, the bottom of the bag being formed by the remaining, unslitted fold of the previously tubular web, or single tear and separating lines may be formed adjacent transverse heat seals. Alternatively, a single flat web is folded over, and bags are then formed by making transverse heat seals, with tear-off lines therebetween. This alternative method requires, during manufacture, a folding station. Regardless of how made, the two layers of polyethylene material, which are very thin, tend to adhere together. This adhesion is due not only to air pressure against the two sides—the plastic bag material is air-impervious—but also due to static electricity which is picked up by the rolls during the manufacture and during passage over transport, tension and idler rollers. The plastic material, itself, being a good insulator leaks charges only very slowly.

The polyethylene film, from which such bags have been made is in appearance transparent, and smooth. Differentiation between bags, for example, for containing one substance and another can be made only by tinting or colouring the base material, which introduces additional expense. The smooth film will stick not only to itself, making unrolling from a roll and thus dispensing more difficult but will also stick to the skin of the user, leaving the user with a disagreeable feel. While the smoothness provides for good sealing of two surfaces of the film against each other, it does have the disadvantage that it makes the bag harder to open and the material unpleasant to handle.

It is an object of the present invention to provide an inexpensive method to manufacture embossed plastics film, especially polyethylene webs and continuous rolls of bags, formed as strips of detachable bags which we refer to as a bag structure; such embossed film having a better feel (termed a "softer hand"), better appearance, enabling variation of appearance, and layers of which in a bag do not have the tendency to stick together or to the hands of the user.

According to the present invention a method of embossing a continuous web composed of one or more flexible plastics films each of 0.025 mm thickness or less comprises passing the web between a pair of embossing rollers having, on their respective surfaces, positive and negative embossing patterns, while controlling the circumferential speed of said rollers to be less than the speed of the web supplied to said rollers. The smooth plastic web is fed to the embossing rollers at a speed higher than the linear circumferential speed of the embossing rollers to permit the web to pucker. The

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embossed web is preferably also pulled from the rollers at higher than roller speed to stretch the corrugations; the speeds of application of the web to, and withdrawal from the rollers, may advantageously be substantially the same. The relative speeds depend on the depth of the embossed deformations, their shape, film thickness and strength, and similar factors, and can be determined experimentally. If the web material is tubular, it is then preferably separated by passing it through a pair of pinch rollers and introducing an air bubble between the layers. The surface temperature of the embossing rollers may be controlled to be above, or below ambient temperature; in actual operating experience it has been found that at high speed it is preferred if the embossing rollers are artificially cooled.

According to a further feature of the invention a bag structure is formed of the aforesaid embossed plastics material having a thickness of .025 mm or less and fused together along one side edge, or along both side edges, or in a flattened tubular form. The bag shape is determined by the position of the bag mouth and its position in relation to other bags on a continuous web, later reeled on a roll. Preferably, the embossing patterns are similar on both sides, that is layers of the bag, and, further, may be in registration, that is the patterns may match, in the region of the fused lines. The two layers of the bag will not normally, even when wound tightly, lie in perfect registration since slight distortion will result, so that the bags will open easily, although both layers may have been embossed simultaneously during one passage of both layers, in overlying relation, through a pair of embossing rollers as about to be described. The embossing pattern itself may, for example, be in the form of a truncated pyramid or the like, of approximately 0.5 mm depth (or, looked at from the other side of the bag—height), although different dimensions and different shapes may be used as desired, provided the material is not so deformed as to lose strength.

Difficulties have been experienced in mass producing embossed film, as thin as 0.015 mm thick due to its limp nature and thinness, which is hole-free and of continuous uniformly high quality output. Only when the embossing was between a pair of matching, driven embossing rollers was it found possible to provide consistently reject-free material. The impressions can be arranged to ensure point contact of the impression rolls so as to give a fine pattern; the resulting material will then have the appearance of somewhat increased thickness. The pattern may consist of adjacent squares or diamonds, or for example, may form an interlocking pattern such as a beehive pattern which may result in some increase of stiffness of the material, similar to an increase of stiffness in corrugated sheets. The appearance appeal, that is the aesthetic appeal can also be changed by changing the embossing pattern, resulting in changes in light reflection and refraction of light passing through the material. By embossing, scratch blemishes tend to disappear. The embossing depressions (and, conversely, projections) may be shallow. The depth of the depressions is limited by the material strength and the deformation reaches a limit when the film becomes weakened at the deformation lines. If desired, a pointed pattern can be placed at some predetermined locations to purposely weaken the material and provide additional tear lines, in any direction, relative to the travel of the web during manufacture, which is desired.

The invention will now be described by way of example with reference to the accompanying drawings, wherein:—

Fig. 1 is a greatly enlarged plan view of a section of embossed material;

Fig. 2—a is a perspective view, to a still more enlarged scale, of an embossed region of a web of embossed material;

Fig. 2—b is a transverse schematic view through the embossed web;

Fig. 3 is a transverse schematic view of a pair of embossed webs, in overlying matching relation;

Fig. 4 is a transverse schematic view of a pair of embossed webs, offset for ease of separation of the two webs, drawn to an exaggerated scale;

Fig. 5 is a partial view of bag structures, in continuous form suitable to be rolled off a roll dispenser;

Fig. 6 is a schematic representation of manufacturing steps to manufacture continuous rolls of bags from a tubular web;

Fig. 7 is a partial view of the manufacturing steps to make embossed bags from a flat web; and

Fig. 8 is a perspective view of an embossing roller having different patterns, and a blank section thereon.

Referring now to the drawings: A web 10, of thin thermoplastic material, for example polyethylene of 0.015 mm thickness is deformed in the shape of truncated pyramids 11, best seen in Figure 2a. The base distance between the pyramids, indicated at dimension a at Figure 2b may, for example, be about 1.5 mm; the angle of the sides, B may be 60° and the depth of the pyramid, dimension c in Figure 2b, about $\frac{1}{2}$ mm. The truncated pyramids 11 may be arranged in line with the feed of the web as indicated by arrow 12 (Figure 1) or may be arranged at an angle, for example, at 45° thereto, in diamond fashion. The dimensions above given pertain to polyethylene material of less

than 0.025 mm thickness, typically of 0.015 mm thickness, and have been found suitable to provide the pleasant feel and ease of separation of superimposed layers, but should be considered as an example only.

The method of embossing webs, particularly for bags, is demonstrated in connection with Figure 6 where parts of extrusion line are illustrated.

Plastic raw material is introduced, for example in pellet form into an extruder 20, from which a tubular web of the plastic material is obtained at a tubular die 21. An air bubble is introduced in the tubular web, which then passes between a pair of pinch rollers 22, so that the two sides of the web will be cooled as well as separated. The tubular web is then passed over a number of transport rollers 23, which may be driven. Roller 24 is spring loaded to equalize tension and actuates a speed controller 27 which regulates the speed of the embossing rolls 25 and 26. From transport roller 24 the material passes between the pair of driven embossing rolls 25, 26. From embossing rolls 25, 26 the web is passed over a pull-off roller 28, other transport rollers (not shown), a tension equalization unit 29, if desired, and over further transport rollers to two sets of pinch rollers 30, 31. An air bubble is introduced in the tubular web between the pinch rollers 30, 31, to separate the webs which may adhere together. The webs are then passed over a bag forming station 32 which may, for example, include apparatus to provide transverse heat seals at predetermined locations in the web, tear lines and the like as well-known in the art; and then, over idler roller 33 to wind-up reel 34.

The speed of the web as it is applied to, and withdrawn from the embossing rollers 25, 26 is regulated with respect to the linear circumferential speed of rotation of the embossing rollers themselves, so that the web is passed through the embossing rollers without being subject to stretching or strain on the web itself; as a consequence, the embossing rollers 25, 26 will have a lower linear circumferential speed than the web supply speed, so that the web can be embossed by pressure. The web can be pulled out from between the embossing rollers at substantially the same, or a somewhat lower (but not higher) speed than the speed of feed. Controller 27 thus controls the speed of roller 24, embossing rollers 25, 26, and pull-off roller 28. The relative speeds, and the degree of stretch imparted by the higher speed of rollers 24, 28, than embossing rollers 25, 26, will depend on the thickness and nature of the material, the depth and shape of embossing depressions, and similar factors and can be determined experimentally. For the dimensions given, the pull-off speed at roller 28 can be substantially the same and only a little less, for example 3—5% than supply speed at roller 24 while the embossing rollers 25, 26 speed can be less by 20% or even more of supply speed at roller 24.

Embossing rollers 25, 26 are made of non-yielding material, for example of steel. Embossing roller 25 has the pattern arranged thereon so that the truncated pyramids 11 will project; a matching pattern, with the truncated pyramids formed as recesses is then located on roller 26. The rollers are temperature controlled, preferably cooled below ambient room temperature. The finish of the steel rollers 25, 26 is preferably smooth. Other materials can be used; if runs of comparatively small quantities, only, of specific patterns are needed, one of the rollers, for example, roller 25 may be engraved with a raised embossing pattern. The other roller can then be made with an initially smooth lead surface, the steel roller being used to itself deform the softer lead to make a matching negative embossing pattern thereon. The two rollers, one with the positive and the other with the negative embossing pattern, are then used in place of the two steel rollers 25, 26.

The tubular web, which is in two layers, as it comes from the embossing rolls will, in cross-section have the appearance as seen in Figure 3, where a top web 110 and a bottom web 210 are located in overlying relation—Figure 3 being greatly enlarged and showing the relationship of two webs exaggerated and slightly separated for ease of illustration. After the webs have been inflated that is have passed through pinch rollers 31, the embossing may no longer match and webs 110, 210 may be located as illustrated in Figure 4. This offset of the embossed areas with respect to each other provides a small distance between the webs 110, 210 which may be due to uneven stretching, slight skew and other manufacturing and process imperfections. When thin thermoplastic materials, i.e., on the order of about 0.015 mm or less thickness are employed to form the embossed bag structures of the present invention, it has been found desirable to insure substantially complete inter-wall registration of the embossed pattern (see Fig. 3). Offset or non-registration (as illustrated in Fig. 4) of the pattern when such relatively thin film materials are employed may result in an undesirable distortion of the embossed pattern when compressive forces are applied to the bag walls, e.g., when a series of connected bags are wound into roll form. At the bag forming station 32, transverse heat seals 40, and tear lines 41 are applied to the webs 111, 210 (see Fig. 5). The webs, after having been spooled on take-up reel 34, can be respooled for dispensing from a box B in continuous form. The webs 110, 210, due

to their embossed deformations from flat strips and the usual random overlying relationship, particularly due to the suppleness of the material will separate easily, and further provide a softer hand and more pleasant feel to the user.

It is also possible to emboss single layer webs. Referring to Figure 7, a single layer web 310 is passed through a pair of driven rollers 324, connected to a speed control 327, which also controls the rotational speed of the pair of embossing rollers 325, 326 as required by the invention. The embossing rollers are temperature controlled, for example, by selectively passing hot or cold water therethrough through lines H, and C, respectively, the water being taken out by a drain line D. The pattern on the embossing rollers 325, 326 need not be continuous or be the same throughout the entire length of the roller. Figure 8 illustrates a roller 425 which has a first diamond shaped embossing section 50, followed by a blank section 51, followed by a square embossing section 52. The shapes of the embossing projections (and in the matching roller, not shown, embossing cavities) may, again, be as desired by the eventual appearance of the materials. The embossings may be interlocked, square, hexagonal or have any other suitable shape desired by a designer.

Referring again to Figure 7, the embossed flat web can be folded into suitable shape in folding station 330 which, by in itself, is well-known in the art into a double layer web as indicated schematically by the double lines at the terminal end of station 330. The double webs now having a top layer 311 and a bottom layer 312 can, again, be passed through a bag forming machine 332 and then be spooled up on a take-up reel 334.

When bags are made with embossing rollers 425, as illustrated in Figure 8, the embossing pattern on the top layer 311 may be different from the pattern of the bottom layer 312, so that non-coincidence of the embossing pattern will necessarily result, thus further improving ease of separation. If bags are to be made from such a folded-over web, one side of the web will have a closed fold along one longitudinal edge and a pair of heat-fuse lines, one each adjacent a weakened tear line. The continuous web may then be separated into individual bag units. The web may also be folded from both sides towards the middle so that double pocket bags can be formed. The web may be folded, for example, in regions where the embossing rollers do not have an embossing pattern applied thereto, that is in region 51 (Fig. 8), or at a change from one pattern to another, with no unembossed intermediate position separating adjacent embossed patterns.

If flat, embossed webs only are required as distinct from bags as such, the folding and bag forming stations 330, 332 (Fig. 7) may be omitted; the webs may be embossed by rollers as illustrated in Figure 8, or by rollers which have only one pattern thereon.

WHAT WE CLAIM IS:—

1. A method of embossing a continuous web composed of one or more flexible plastics films each of 0.025 mm thickness or less, comprising passing the web between a pair of embossing rolers having, on their respective surfaces, positive and negative embossing patterns, while controlling the circumferential speed of said rollers to be less than the speed of the web supplied to said rollers.

2. A method according to claim 1 including the step of cooling the surfaces of the rollers.

3. A method according to claim 1 or 2 in which the web is pulled from the embossing rollers at a speed substantially the same as the speed of the web supplied to the rollers.

4. A method according to any of claims 1 to 3 in which the web is a tubular double layer web which is passed with both layers of material in overlying relation through the rollers to emboss both layers simultaneously with the same pattern, the method including the step of separating the layers after embossing to prevent them from sticking together.

5. A method according to claim 4 in which the step of separating the layers is accomplished by passing the embossed layers successively between the rollers of spaced pairs of pinch rollers; and introducing an air bubble into the tubular material between the layers in the zone between the pairs of pinch rollers.

6. A method of embossing a continuous web of flexible plastic sheet material, substantially as herein described with reference to Figure 6 or 7 of the accompanying drawings.

7. A method of manufacturing a continuous bag structure, which comprises embossing a single layer flat web of flexible plastics material by a method claimed in any of claims 1 to 3, folding the web of material lengthwise over itself to form a two-layer web; heat fusing the layers together along lines transverse to the web so as to demarcate the web into individual bag units; and forming a tear line of weakened material adjacent each fuse line to enable ready separation of the bag units.

8. A method according to claim 7 wherein said step of heat fusing said fuse lines includes the step of heat fusing said layers together with said embossing patterns in substantial registration.

9. A method according to claim 7 in which the embossing rollers bear different

patterns in axially spaced zones thereon; and the web is folded in the resultant region of change from one pattern to another on the embossed web.

10. A method of manufacturing a continuous embossed bag structure, substantially as herein described with reference to Figure 7 of the accompanying drawings.

11. A method of manufacturing a continuous bag structure which comprises embossing a tubular, double layer web of flexible plastics material by a method claimed in claim 4 or 5, heat fusing said layers together along fuse lines to demarcate the web into individual bag units; and forming a tear line of weakened material adjacent each fuse line to enable separation of the bag units.

12. A method according to claim 12 in which the fuse lines are formed with the embossing patterns of the layers in substantial registration.

13. A method of manufacturing a continuous embossed bag structure, substantially as herein described with reference to Figure 6 of the accompanying drawings.

14. A continuous web of flexible plastic sheet material when embossed by the method of any one of claims 1 to 6.

15. A continuous bag structure when manufactured by the method of any one of claims 7 to 13.

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1301198 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1

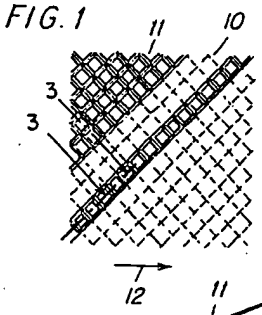


FIG. 2b

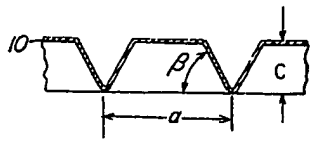


FIG. 2a

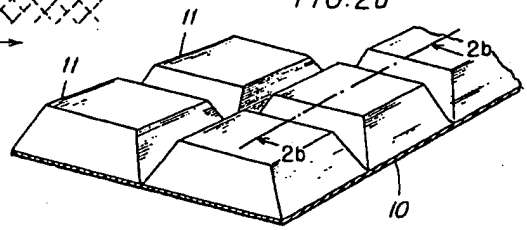
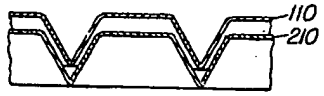


FIG. 3



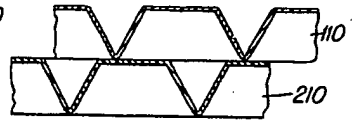


FIG. 4

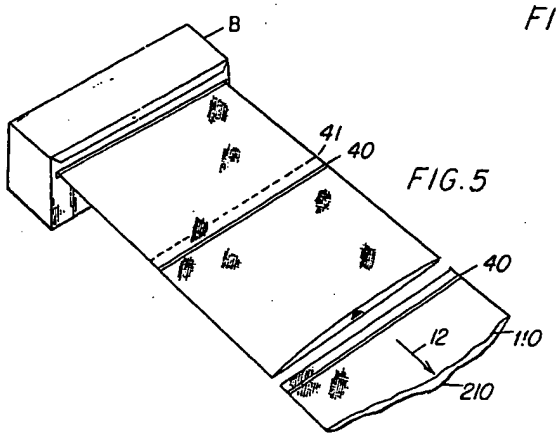


FIG. 5

FIG.6

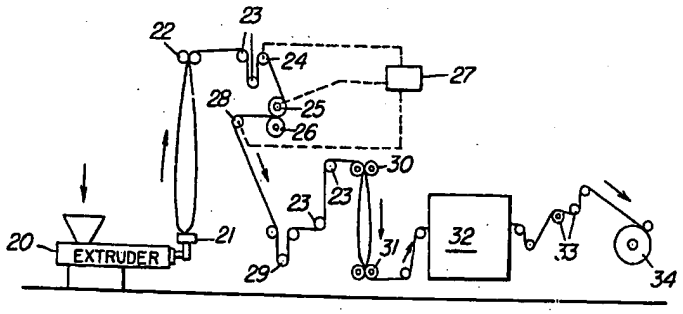


FIG.7

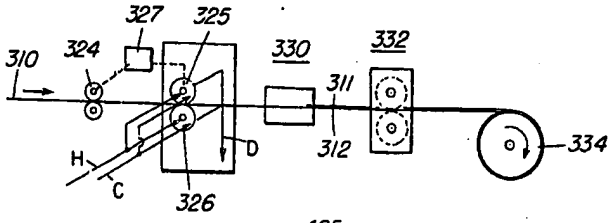


FIG.8